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THE SOLAR ECLIPSE OF JUNE 30, 1954, IN NORTHERN CANADA*

BY JOHN F. HEARD

IF you have read your OBSERVER'S HANDBOOK for 1954 you will be aware that Canada is to be favoured on June 30th with a total eclipse of the sun. Unfortunately, the band of totality does not pass over regions very close to where most of us live, but it does cross No. 11 highway and the Canadian National Railway near the lovely little city of Kapuskasing in Northern Ontario, so it is not too inaccessible. You may be wondering, though, if it is an event worth a 1200 mile drive or a $40.00 train ride from Toronto. So I thought I would like first to review briefly the cause and nature of total solar eclipses, discuss their frequency, tell you about this eclipse and what you might expect to see if you go to the path of totality, and, finally, using a few examples, discuss the scientific importance of eclipses in general and of this eclipse in particular.

Everyone knows that an eclipse of the sun is caused by the intervention of the moon precisely between earth and sun. The phenomenon is not visible over the whole earth because the tip of the moon's shadow cone which touches the earth is not very big, seldom more than 100 miles across. As this shadow sweeps across the earth at a speed of about 2000 miles an hour, observers in the narrow band called the path of totality see the main part of the sun blotted out by the moon for a period up to a few minutes. Observers near the path see the sun partly eclipsed. But there is a world of difference between the spectacle afforded by a partial eclipse and by a total eclipse. It is interesting, of course, to see a slice taken out of the sun at a partial eclipse, and nearly everyone has seen this. But it is nothing short of thrilling to see the sun totally eclipsed,

*Address by the President of the Royal Astronomical Society of Canada at the Annual At-Home, in Toronto, on January 15, 1954.

the black disk of the moon ringed with the rosy light of the chromosphere, studded perhaps by the Baily's Beads where sunlight still peaks through lunar valleys, and the whole surrounded by the glorious pearly glow of the corona with pale streamers reaching out to distances of several solar diameters. No one who has seen this spectacle denies that it is worth waiting a lifetime to see—and not many people see it in their lifetime, total eclipses being as rare as they are in any one locality, and clouds being, unhappily, as common as they are.

Some of you here this evening will recall the disappointment at Toronto and over most of Ontario when clouds spoiled the promised views of a total eclipse here on January 24th, 1925; and some of you, I know, went to Quebec to see the eclipse of August 31st, 1932. I tried to see both of these eclipses, in 1925 as a member of Dr. H. R. Kingston's party in London, Ontario, and in 1932 as an assistant to Prof. Herbert Dingle of London, England, who had set up a spectrograph on the roof of the McGill University Physics Laboratory. Clouds interfered in both cases.

On July 9th, 1945, I had another chance, this time the privilege of taking part in the R.C.A.F. airborne eclipse expedition in Manitoba directed by Dr. Peter M. Millman. Over most of the path in Manitoba and Saskatchewan it was cloudy, but this time there was a chance to foil the clouds if we could navigate the aircraft by sun and radio so as to be in the required path at the required time. All the aircraft taking part were navigated successfully. I shall never forget the thrill of watching the moon's shadow sweeping towards us across the clouds below with incredible swiftness, and that beautiful sight of the black disk in the sky surrounded by the chromosphere and, as I remember it, a mauve coloured corona of jagged outline. Figure 4 shows a photograph taken from the air at that expedition.

How rare are total eclipses? In one sense not at all rare, since there must be at least two solar eclipses somewhere on the earth each year and there may be as many as five; in another sense very rare, as figure 1 illustrates. Here, sketched from Oppolzer's famous *Canon der Finsternisse*, are all the total eclipses which have passed into Canada (except a few which were confined entirely to Arctic regions) since John Cabot arrived on our shores in 1497. Actually there are only 28 on this diagram for that 457 year interval. You see that Toronto and vicinity has been favoured with only two total eclipses, namely those of June 16th, 1806, and January 24th, 1925. Except for those, Torontonians would have had to go several hundred miles to see total eclipses. The rest of our lifetimes

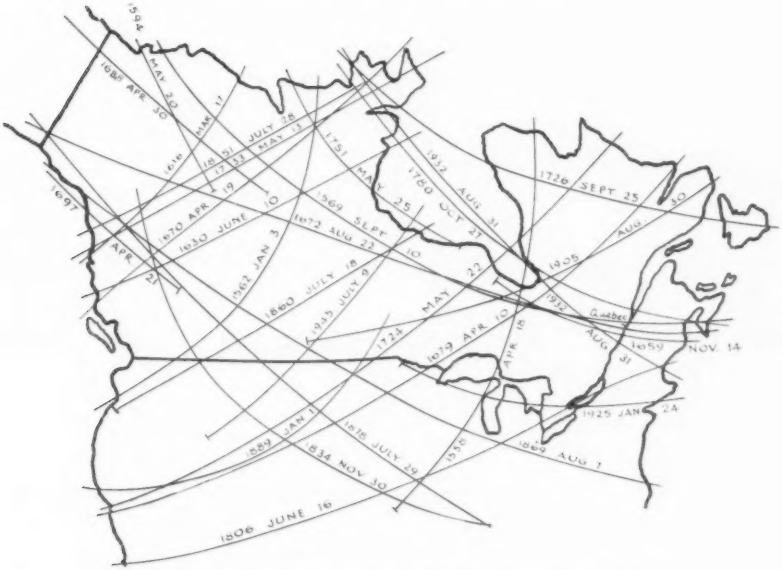

FIG. 1—Land paths of total solar eclipses in Canada, 1497–1953.

will be worse. In figure 2 are sketched the paths of all North American total eclipses from now till 2025. Apart from the 1954 eclipse in Northern Ontario and the 1963 eclipse in Eastern Quebec and the Maritimes, you see that the prospects are not good. In any event, if you live in Toronto you will certainly have to leave home to see a total eclipse, for the next total eclipse to touch Toronto will be on Ocober 26th, 2144. To take Toronto as an example, it is a long time between total eclipses—1925 to 2144.

Returning to figure 1, I thought you might be interested, as I was, to know if some of the early eclipses shown on the diagram had actually been recorded by the early settlers of our country. Professor Flenley of the Department of History of the University of Toronto suggested to me that I might find some references to eclipses in the Jesuit *Relations*, that remarkable collection of the chronicles of the Jesuit missionaries in the New World. There are, indeed, a good many; the Jesuits had a specific interest in eclipses, namely to observe the times of predicted eclipses in order to establish the longitudes of their settlements.

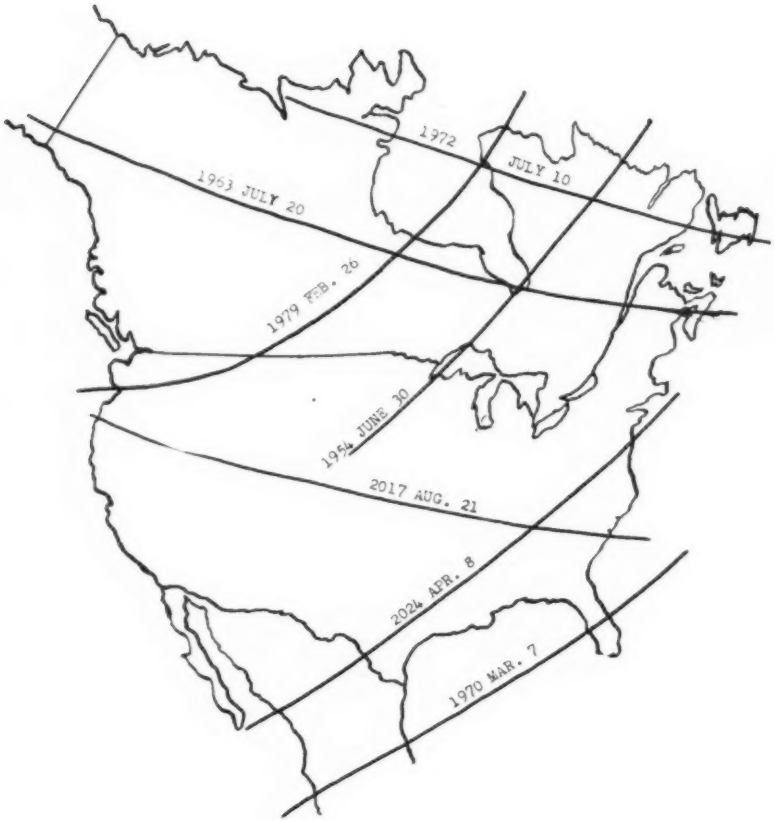

FIG. 2–Total solar eclipses, 1954–2025.

There are two references to the eclipse of April 19, 1670. From the Mission in Wisconsin the Jesuits wrote that, "We observed the Eclipse of the sun predicted by the astrologers which lasted from noon till 2 o'clock; a third of the sun's disc appeared to be eclipsed; the other two thirds making a crescent". And from Quebec: "It began at a quarter before 2 o'clock and ended at 23 minutes after 3, its total duration being 1 hour and 40 minutes. The extent of the Eclipse was a little more than 5 fingers."

From the Mission in Wisconsin Father Claude Allouez wrote concerning the eclipse of August 22, 1672, "I noticed the eclipse of the sun which occurred about 11 o'clock. I could not well observe its notable features. The savages did not trouble themselves about it." This 1672 eclipse must have been total or nearly so at Quebec, yet there seems to be no record of its having been observed by the Jesuits there. Probably it was cloudy. I was also a little surprised to find no references to the 1659 eclipse which must have been nearly total at Quebec.

Other of the eclipses mentioned in the *Relations* as having been observed were partial in Canada or were annular (the tip of the shadow cone not quite reaching the earth) and are thus not shown in figure 1. There appears to be no reference to a total eclipse observed as such.

That the Indians had not always been as indifferent as Father Allouez' "savages" is shown from a letter of Father Le Jeune in 1634 who wrote: "I asked them whence came Eclipses of the Moon and of the Sun. They answered that the Moon was eclipsed, or appeared to be dark, because she held her son in her arms which prevented her brightness from being seen. 'If the Moon has a son, she is married, or has been', I told them. 'Oh, yes,' they replied, 'the Sun is her husband, who walks all day, and she all night; and if he be eclipsed, or darkened, it is because he also sometimes takes the son which he has had by the Moon, into his arms' ". When Father Le Jeune asked them "why the son of the Sun and the Moon was not bright like his parents, but black and gloomy," they merely said that they didn't know, they had never been in the sky.

To return to this year's eclipse: it begins at sunrise near Minneapolis, passes over the centre of Lake Superior, crosses Northern Ontario to the tip of James Bay and thence across Northern Quebec and the coast of Labrador. It passes over the tip of Greenland, just south of Iceland, across Scandinavia, Poland, the Ukraine, Georgia, Iran, Pakistan, and ends in India at sunset. This course is about 8000 miles long and is covered in the interval of time between sunrise in Minnesota and sunset in India, namely in about 2¾ hours; thus the average velocity of the moon's shadow over the earth is about 3000 miles per hour. The best place to observe this eclipse will be Scandinavia where it will occur about at noon with the sun high in the sky (about 51°) and where totality will last longest, about 2½ minutes.

It is of interest to notice that the band of partial eclipse extends far beyond the path of totality, embracing nearly all of Canada, eastern United States, all of Europe and much of Africa. In Toronto the partial eclipse will begin at about 5:09 a.m. E.S.T. and end at about 7:02. At mid-eclipse, about 6:05, approximately 85 per cent. of the sun's surface

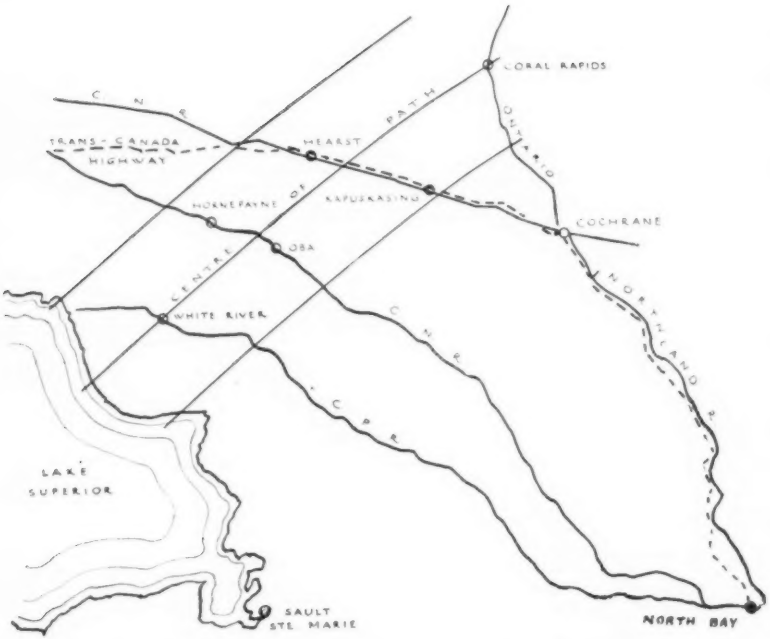

FIG. 3—Eclipse path in Northern Ontario, June 30, 1954.

will be covered by the moon. As I have said earlier, it will be an interesting phenomenon to watch, but everyone must be warned to protect the eyes with smoked glass or a piece of good black photographic film.

The real interest for Canadians lies in that part of the path of totality between Lake Superior and James Bay, for it is this region which is accessible by road, rail and air. Figure 3 shows the relation of the path to the important road, rail and airway points. The eclipse path is here about 80 miles wide, and the duration of totality on the centre line is about a minute and a half. Time of mid-totality ranges from 6:10 a.m. E.S.T. to 6:15, depending on the location. The altitude of the sun will be about 15° and its azimuth 71° east of north.

From the sketch map of this region you will see that White River on the C.P.R. and Coral Rapids on the Ontario Northland and Oba and Hornepayne on the main line of the C.N.R. are close to the centre line, and that within the band of totality are Kapuskasing and Hearst and a number of smaller places between them, all on the Northern Line of the

C.N.R., and also on the Trans-Canada Highway (no. 11). Kapuskasing is connected by air to Toronto via T.C.A. with a four-hour service. If you should plan either a private trip or a Society excursion, you should bear in mind that many of the small places on rail and highway offer little or nothing by way of overnight accommodation or restaurants. This is not true, however, of Kapuskasing and its environs; there are fine hotels, cabins and restaurants there. No doubt it would be wise, nevertheless, to make reservations in advance. Kapuskasing is 18 hours from Toronto by rail, the return fare is $39.70, and the trains carry sleeping cars on this service. The drive from Toronto to Kapuskasing is nearly 600 miles; as far as Cochrane the highway is excellent, beyond Cochrane (about 80 miles) it is mostly unpaved and rough.

Before planning an eclipse expedition, whether private or scientific, one must take a realistic attitude towards the weather probabilities. This part of Northern Ontario is notoriously cloudy. A recent survey of the weather data for this region has shown that in the early morning in late June there is only a 30 per cent. chance of a clear sky. If you plan to go you must be 70 per cent. prepared for complete disappointment.

Let us consider now a few of the scientific aspects of total eclipses with particular emphasis on those problems which may be tackled in our country at this year's eclipse.

The Flash Spectrum. At the 1954 total eclipse, as at all total eclipses since 1870, efforts will be made to observe the phenomenon known as the *flash spectrum*. Before discussing this phenomenon I must recall for you the spectrum of the sun as it is observed normally and the conclusions which we draw from it.

A spectrograph, you will remember, is an instrument which breaks up light into its constituent colours or *wave-lengths*. The array of colours so produced is called the spectrum of the particular light source. For an incandescent solid like a light bulb the spectrum is *continuous*, that is, all colours or all wave-lengths are present. An incandescent compressed gas also gives a continuous spectrum. On the other hand, for a glowing, rarefied gas, as in a discharge tube, the spectrum consists of certain narrow strips of colour called *spectral lines*. These spectral lines, specified by their wave-lengths, are characteristic of the particular gas and are produced by the atoms of the gas acting independently of each other. Each gas, for example helium, sodium vapour, iron vapour, etc., produces its own characteristic spectrum which is always the same providing the conditions of excitation in the gas (for example temperature) are high enough to produce light at all, but not so high as to *ionize* the gas, that

is, to remove electrons from the atoms of the gas. If the temperature is high enough to ionize the gas a new kind of spectrum is produced which we call the *ionized spectrum* as contrasted with the *normal spectrum*.

Now when Fraunhofer, in 1814, first observed the spectrum of the sun in detail he was puzzled to see that it was a curious mixture of continuous spectrum and lines—not bright lines superposed on a continuous spectrum, but dark lines existing like gaps in the continuous spectrum. These dark lines, called *absorption lines* or *Fraunhofer lines*, were at the same wave-lengths as the bright lines observed in the spectra of familiar substances like hydrogen and iron. The explanation put forward not long afterwards by Kirchhoff was that the sun consists of a source of continuous spectrum overlaid with a layer of gases in such a state of temperature as to be capable of *absorbing* the characteristic wave-lengths which, in other circumstances, they would *emit*. Moreover, it soon appeared that the neutral or non-ionized vapours predominated in the sun's atmospheric mixture. So we may say that the sun's shining surface, which is responsible for most of the light, and which we therefore call the *photosphere*, is overlaid by an atmospheric layer which has a temperature high enough to put such gases as iron into a state in which they can absorb their characteristic wave-lengths, but not high enough to ionize many of the atoms.

What kind of spectrum could we expect from the disappearing crescent of the sun just as totality approaches? On the basis of the simple explanation of the Fraunhofer lines just discussed, I think we could infer, as did the astronomers of the 1860's, that, as the photosphere was just covered, the sun's atmosphere would shine by itself for a brief moment before it too was covered, and in this interval the dark Fraunhofer lines would become bright. The thrill of seeing this confirmed came to the Princeton astronomer, C. A. Young, in Spain on December 22, 1870. I can do no better than to quote his own words: "At the moment the sun is hidden, through the whole length of the spectrum, in the red, the green, the violet, the bright lines flash out by the hundreds and thousands, almost startlingly; as suddenly as stars from a bursting rockethead, and as evanescent, for the whole thing is over in two or three seconds. The layer seems to be only something under a thousand miles in thickness, and the moon's shadow covers it very quickly."

At succeeding eclipses, as other astronomers reobserved this *flash spectrum* with improved equipment, and finally by photographic means, there began to appear some unexpected features. For one thing, when there was no artificial narrowing of the light beam by the use of a slit in the spectrograph, that is, when the solar crescent was allowed to act

itself as a slit, and when, accordingly, the spectral lines appeared as fine crescents, then the crescents arising from different vapours were not of the same lengths. The only conclusion to be drawn was that the different vapours rose to different heights above the photosphere. Thus hydrogen and calcium were found to produce long crescents and so must be excited at great heights—many thousands of miles, while iron produced only short crescents and so is excited only at heights of a few hundred miles. S. A. Mitchell and others have measured crescent lengths by the thousands and have tabulated the heights to which various vapours extend. Moreover, there was not an exact matching of the Fraunhofer lines of the ordinary solar spectrum with the bright lines of the flash spectrum. In particular, the lines of ionized vapours were favoured in the flash spectrum—especially at great heights. So astronomers were faced with these new problems: How is the sun's atmosphere supported at thousands of miles above the photosphere, and how can it possibly be hotter there than it is right next to the photosphere? The theoretical work of the great Indian astrophysicist, M. N. Saha, has pretty well answered the latter question: it is not entirely high temperature that produces the strong degree of ionization high in the sun's atmosphere; extremely low pressure also plays a role. Nevertheless, refined measurements, particularly by R. O. Redman of Cambridge, still lead to unexpectedly high temperatures in the sun's atmosphere. And the other question of the support mechanism for the atmosphere still remains unsatisfactorily explained. Meanwhile the need continues for renewed and improved observations of the flash spectrum. You might think that if astronomers haven't been able to study the flash spectrum thoroughly enough in 83 years, there must be something wrong. But consider the fewness of the suitable total eclipses in reasonably accessible places, consider that the flash spectrum shows for a matter of seconds at each eclipse, consider the number of attempts that fail through clouds or accidents, and you will realize that the 83 years become less than 83 minutes of actual observing.

At the 1954 eclipse three Canadian parties in Northern Ontario will attempt to study the flash spectrum. A party under the direction of Dr. J. L. Locke of the Dominion Observatory will attempt to photograph the flash spectrum in the neighbourhood of a private power company at Smoky Falls, about 40 miles north of Kapuskasing. They will use a large grating spectrograph equipped with a slit, and will hope to obtain high dispersion spectrograms in the blue region of the spectrum for the purpose of studying line intensities. The Dominion Astrophysical Observatory will send a small party directed by Dr. K. O. Wright to Hansen, 17

miles north of Oba. They will use a slitless grating spectrograph of moderate dispersion and will attempt to photograph the violet region with a view to studying heights at which the bright lines appear and the intensities of these lines. A party from the David Dunlap Observatory will be located at Mattice, about half way between the two sites already mentioned, and we will attempt to photograph the flash spectrum with a slitless grating spectrograph of fairly low dispersion in the far red, a region where the flash spectrum has not often been observed. The three sites are spread out over a distance of about 125 miles, and we hope that at least one of the parties will be favoured with clear skies on eclipse day.

To make a good photograph of the flash spectrum it is necessary to have rather elaborate equipment. However, anyone should be able to observe the flash spectrum by eye with inexpensive equipment, and recapture the thrill of C. A. Young's original observation. It is something I would like to recommend to anyone who may plan to go to the path of totality and who is interested in optical gadgets. All you need is a replica transmission grating with about 5000 lines to the inch, and a pair of binoculars. I understand a suitable grating can be bought from Central Scientific Co. of Canada for about $7.00. Fix the grating, with the lines horizontal, in front of one objective of the binoculars, masking off the unruled part of the grating, and put a smoked glass or a dark film over the other objective. When totality approaches watch the narrowing crescent of the sun through the darkened objective, tilting your head so that the crescent is seen "horizontally" in the field. When the crescent is just about gone open the other eye, squinting cautiously at first in case the image is still too bright, and if necessary move the binoculars up or down a bit until you see the spectrum. When the crescent has narrowed sufficiently you should see crescent-shaped Fraunhofer lines. Watch them change from dark lines on a bright background to bright lines on a dark background. This is the way S. A. Mitchell times the onset of the flash spectrum for his photographs. In the same way you can watch for the appearance of the flash spectrum and the reverse order change to Fraunhofer spectrum at the end of totality. I hope some of you may try it at the coming eclipse.

The Corona. The beautiful glow of soft light which can be seen about the sun at the time of totality is the sight which, more than anything else, makes a total eclipse one of nature's greatest spectacles. But it is more than a beautiful sight; for the past century it has been a challenge to the astronomers who have gradually been learning the secrets of the

sun's mechanism. The shape of the corona, the way its light falls off from the sun's limb outward, the way its light is polarized, the spectrum of the light, these are all features which have been studied and are still studied at every eclipse. When we have ample observations and convincing interpretations of all these things we will be a great deal closer to a complete understanding of the nature of the sun.

What, in the first place, causes the corona? Several things, apparently, to judge from the nature of the light and the way it is polarized. A fraction of the light produces a bright-line spectrum of extremely high degree of ionization, indicating the presence of ions far from the sun. Another fraction of the light has a continuous spectrum and is polarized, indicating the presence of high energy electrons which are scattering sunlight. Still another part of the light shows a Fraunhofer spectrum, which is taken to indicate the existence of solid particles in the neighbourhood of the sun—an inward extension, perhaps, of the same cloud of particles which produce the zodiacal light often visible just after sunset on a spring evening. But all these kinds of light are originating together and have different relative intensities in different parts of the corona. To sort them out and to establish the distribution of the various particles is a difficult task which will require a good deal more observational data.

There is another famous and interesting problem having to do with the corona, namely that of the relation of its shape to the sun-spot cycle. It has been known for many years that when the corona is observed at sun-spot minimum long streamers are seen extending from the equator of the sun and short plumes from the poles, whereas at sun-spot maximum the streamers are more evenly distributed around the sun and the polar plumes are less prominent. A way of obtaining a numerical figure for the shape of the corona was put forward by Ludendorff in 1928. This involves making intensity measurements of a photograph of the corona and then drawing *isophotes*, or lines of equal intensity. If the intensity distribution in the corona were perfectly symmetrical, then the isophotes would be circular; but more often than not the equatorial streamers give the isophotes a roughly elliptical shape, the long axis being in the direction of the sun's equator. This is illustrated in figure 4 which shows the corona of the 1945 eclipse as photographed from 17,000 feet in the R.C.A.F. expedition, and also the isophotes determined from this photograph. Now the degree of ellipticity for these isophotes may be expressed numerically, and this has been done for many previous eclipses. Ludendorff and others have found that there is a fair degree of correlation between the ellipticity of the isophotes and the solar cycle; the most

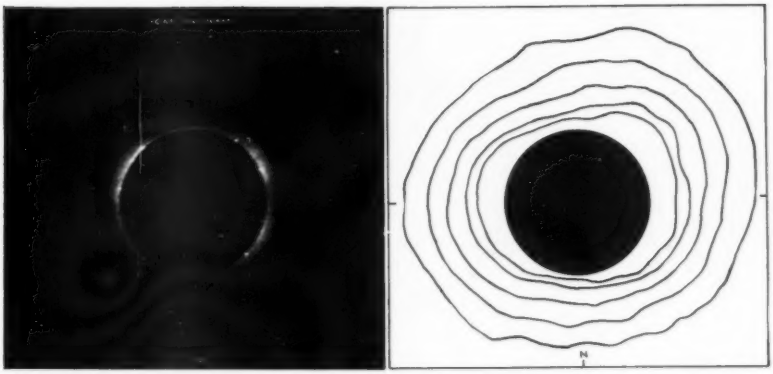

FIG. 4—*Left*: Solar corona at eclipse of July 9, 1945. *Right*: Isophotes determined from this photograph.

circular isophotes occurred a year or two before sun-spot maximum, the most elongated ones occurred a year or two before sun-spot minimum. The 1945 isophotes agree pretty well with this correlation: the ellipticity is moderate, the eclipse occurred about three years before the 1948 sun-spot maximum. The 1954 eclipse will be occurring just before predicted sun-spot minimum, and one would be tempted to predict more elliptical isophotes.

Another line of investigation of the corona to which I have already referred is the polarization of the light of the corona. Polarized light is a phenomenon now familiar to most people who have worn polaroid glasses at 3D movies. We see different pictures through the two halves of the glasses because the light of the two pictures on the screen is polarized differently. Now the light of the corona is polarized, and, while you would not expect to see a 3D picture of it through polarized glasses, you could expect to see it slightly (though perhaps imperceptibly) different through the two glasses. This polarization of the coronal light is supposed to arise from the scattering of light by electrons. But the degree of polarization appears to fall off appreciably with increasing distance from the sun's limb, an indication that at greater distances an appreciable amount of light is scattered by some other particles—probably small solid particles.

At the 1954 eclipse the David Dunlap party hope to make new observations of the polarization of the corona using a quadruple camera which was designed by Dr. C. A. Chant and Dr. R. K. Young for the 1922

Australian expedition of the University of Toronto. It was Dr. Young who did one of the early investigations of the polarization of the light of the corona in 1911, using photographs of the 1901, 1905 and 1908 eclipses.

Perhaps some of you who go to the eclipse might like to try some photographs of the corona. If you have some experience of photographing through your telescopes you may succeed in obtaining good large-scale photographs of the corona. I would suggest exposure times comparable to what you would give for a quarter-phase moon—longer if anything. If you decide to try it with a camera alone, bear in mind that the image of the moon will be pretty small; with a miniature camera it will be only about one sixtieth of an inch on the film, with a larger folding camera it will be about one twentieth of an inch. I would suggest an exposure time of one hundredth of a second at wide aperture (say F4.5) with fast film, or one twenty-fifth at full aperture with colour film—perhaps longer if your camera is on a tripod.

The Geodetic Problem. Important efforts have been made in recent years to use total eclipses to measure the dimensions of the earth itself. Let us see, first, why we need an improved value of the size of the earth, and then how an eclipse lends itself to such an improvement.

To measure the size and shape of the earth, geodesists must relate differences of latitude and longitude among many points on the earth's surface with the corresponding differences in distance. On a single continent this can be done in a continuous manner by surveying methods, but between continents the oceans are, to say the least, unsuited to the surveyor's tripod. The result is that the surveys of the several continents are poorly connected, so that, whereas the distance between two stakes, one in Saskatchewan and the other in California, might be known to an accuracy of a few yards, the distance from the California stake to an Australian stake might be uncertain by hundreds of yards.

The elimination or reduction of such uncertainties in earth distances is important for more reasons than first meet the eye. The uncertainties exist in the first place because the direction and magnitude of gravity, on which geodesists base their regular determinations of the earth's dimensions, are dependent on the crustal structure of the earth. To a degree, it is a vicious circle: if the crustal structure may not be presupposed, then the precise dimensions of the earth are not determinable; if the precise dimensions are not known, then the crustal structure is not determinable. The situation can be relieved only by methods of measuring the earth which are independent of gravity. Such methods, then,

could lead to improved dimensions for the earth, and, at the same time, improve knowledge of the crustal structure.

Let us see how a solar eclipse can help. In predicting the exact moment of the beginning or end of totality, I believe you will realize that the astronomer must have accurate knowledge of the motions of the earth and moon and sun relative to one another, and also of the shape and size of the earth. To see how the last mentioned enters into the picture, we might take this example: Suppose two places on the earth, located by the best geodetic manner, are chosen for eclipse observation. With the use of the best data available, suppose that it is predicted that the eclipse path between the two places covers precisely 5000 miles at an average speed of 2500 miles per hour. The interval of time between the beginning of totality at the two places should be exactly two hours. Suppose now that, by very exact observations, we find the time interval to be greater than two hours by one tenth of a second. If we are sufficiently confident of all the data used in the prediction except the length of the path, we could conclude that the path was longer than 5000 miles by $1/10 \times 2500/3600$ miles, or about 120 yards. This figure could represent a great improvement in the measured dimensions of the earth. The example I have cited is over-simplified, but the figures are reasonable.

Now the question is: Is it possible to time the beginning of totality with an accuracy of one tenth of a second so as to get this useful improvement in geodetic results? This is the problem which a number of astronomers, particularly in the United States and in Sweden, have been tackling since 1936 with increasing promise of success. The timing problem presents no serious difficulties, since all observers may use the same radio time signals. The difficulty lies, rather, in deciding the precise moment of the beginning of totality. The Americans have developed a method involving precise recordings, by a photoelectric cell, of the rapid decrease of brightness as the moon's limb finally covers the sun's photosphere. The Swedish astronomers prefer a method involving rapid motion pictures of the development of the flash spectrum. They expect, by careful analysis of the successive frames of the film, to be able to decide the exact moment of the disappearance of the photosphere with an accuracy of better than a tenth of a second.

At the 1954 eclipse I understand there will be three Swedish parties in Scandinavia and three American parties in Labrador, and that they will all use both the methods in an effort to link the geodetic surveys of Canada and Scandinavia. Their results could be of the greatest importance.

In my other two examples of scientific observations at totality, namely flash spectrum and corona, I have indicated that the private observer may, with modest equipment, share in the fun. Again, in this example of timing the eclipse, the private observer may not only share in the fun, but may also obtain data of real importance. He cannot, of course, time the eclipse with the precision required for the geodetic problem, but his data, if obtained carefully, could help to establish errors in the prediction. Eclipses are frequently five to twenty seconds "late", and the predicted paths may be a mile in error.

If you are in the path of totality I suggest you should try, with a stop watch, or with the help of someone calling seconds, to establish the exact moment of the disappearance of the crescent at second contact and its reappearance at third contact. If you try this, be very careful to obtain exact watch corrections over a few days covering eclipse day, and, what is very important, record your position with care. Any observatory will be pleased to receive your results.

During the 1925 eclipse some New York observers made some very interesting and valuable observations to establish the southern boundary of totality. Mitchell, in his book, *Eclipses of the Sun*, explains how this boundary was predicted to cut Riverside Drive somewhere between 83rd Street and 110th Street with a total uncertainty of about one mile, and how a number of interested observers, equipped with dark glasses, stationed themselves every block along this route. With considerable confidence an observer at 240 Riverside Drive reported that the eclipse was total momentarily for him, while another observer at 230 Riverside Drive had seen a small sliver of the sun persisting. The distance involved was only two hundred and twenty-five feet. It would be a fine thing if a group could undertake a similar programme for this year's eclipse, although I must admit that it is asking a lot of an enthusiastic eclipse-chaser to put himself deliberately on the edge of totality.

Other Observations. There are other scientific observations of the greatest importance which may be made only at the time of total eclipse. For example, there is the famous Einstein problem which has to do with the predicted deflection of star light when it passes close within the sun's gravitational field. This was the most important problem tackled by C. A. Chant and R. K. Young at their University of Toronto Australian eclipse expedition in 1922. The low altitude of the sun for the 1954 eclipse on this continent makes it unlikely that the Einstein effect will be reobserved here, though observations may, I suppose, be attempted in Europe. Also

there are radio observations which may be made to investigate problems relating to the earth's upper atmosphere. These need not be made at totality. I understand that Dr. A. E. Covington of the National Research Council will make such observations in his laboratory in Ottawa.

There is one final aspect of this total eclipse as it relates to Canada which I would like to draw to your attention. In an article in December's *Sky and Telescope* Chapman and Stibbs have pointed out that the 1954 eclipse is well adapted to a search for a daytime auroral display. Daytime aurorae are known to exist; the authors quote one instance of an aurora seen in broad daylight without an eclipse and several instances of aurorae observed in bright twilight. An eclipse which occurs, as this one does, in and near the zone of maximum auroral activity, affords an excellent chance to observe a daytime aurora. Such a phenomenon has more than passing interest; particular importance attaches to the forms which daytime aurorae might take. The article urges observers to watch for them during totality.

I fear that this has been in many ways an inadequate coverage of my subject; at the same time I fear that I may have left you with the impression that a total eclipse is as frustrating as a five-ring circus—too many things going on to see any of them properly. But a total solar eclipse is a thrill never to be forgotten, whether you be frantically working cameras, stop-watches, filters and spectroscopes, or just standing there marvelling at nature's grandest spectacle.

MINUTES OF ANNUAL MEETING OF THE ROYAL ASTRONOMICAL SOCIETY OF CANADA

THE combined 64th Annual Meeting and At-Home was held at 8:00 p.m. on Friday, January 15, 1954 in the McLennan Physics Laboratory of the University of Toronto; the President, Dr. John F. Heard, in the chair.

Moved by F. L. Troyer, Recorder, and seconded by J. H. Horning that Minutes of the 63rd Annual Meeting, held January 16, 1953, having been published in the JOURNAL, be adopted as read. Carried.

The Recorder, having been appointed Scrutineer by the Executive Committee, reported a majority of the ballots returned by mail were in favour of the Officers and Council proposed by the Nominating Committee and the President declared these elected as the National Council for 1954.

The National Secretary, National Treasurer and Librarian briefly summarized their reports, copies of which had been distributed to members at the door.

E. J. A. Kennedy, National Secretary, announced the award of the Chant Medal to M. Jean Naubert of the Centre Français de Montréal. J. H. Horning, National Treasurer, pointed out that the National Society's increasing deficit had prompted the Council to appeal for donations (above the amount of annual dues) and that classes of Sustaining Members and Patrons had been established. He also expressed the Society's appreciation to the Editors for their unpaid services and to Mr. Morris Altman, C.P.A., of the Toronto Centre who had given time to auditing the financial books of the National Council. Dr. William R. Hossack then presented the Librarian's report, noting that reorganization of the books in the new quarters had led to greater use. Moved, seconded and carried that the three reports be published in the JOURNAL.

On motion of Mr. Kennedy and Mr. Andrew Thomson, the members present voted unanimously in favour of electing the four Honorary Members proposed by the standing committee of Council. These were: Dr. Walter Baade, Professor J. H. Oort, Professor F. J. M. Stratton and Professor Otto Struve.

Dr. Helen S. Hogg, Second Vice-President, then took the chair and "introduced" Dr. Heard who delivered the Presidential Address on "The Total Solar Eclipse of June 30, 1954 in Northern Canada." (This paper appears elsewhere in this JOURNAL.)

The members and guests then adjourned to the Physics Library where a social hour was enjoyed and refreshments were provided by the Toronto Centre.

FREDERIC L. TROYER, *Recorder.*

REPORT OF THE NATIONAL SECRETARY

THE year 1953 has been a year of change and particularly of concern and anxiety to the Executive Committee of the Council. We received notice to vacate our offices at 3 Willcocks Street in January. It was not unexpected, however. Mr. Barker, a valuable member on the Council, who passed away during the previous year, was also on the Board of our landlord, the Canadian Council of Churches. While he lived he was able to plead our cause, and we were allowed to remain two or three years longer than would have been possible otherwise. As everyone knows, premises are exceedingly scarce at this time, and wishing to be still located near the University made our task more difficult. We were very fortunate, however, in having this year Dr. J. F. Heard as our President. He spent many hours searching the neighbourhood and in fact it was he who discovered our new premises. Our next concern was the moving, and here Dr. W. Hossack, our new librarian, together with Mr. G. Longworth, the mechanical Superintendent at the David Dunlap Observatory, came to our rescue. Dr. Hossack has done a magnificent job of cataloguing and sorting the publications and material which have come to us through the years, mostly as exchanges. A portion of this material is being sold.

Due to the financial stringency, it has been necessary that we endeavour to carry forward our regular programme and office work with part-time secretarial help. Extra detail work has been added with the increase in membership and sale of publications to the extent that the clerical work cannot be carried on efficiently on a part-time basis.

Our office secretary, Mrs. Phelps, resigned in June. During the summer months we were grateful for the help of Miss Fuller to tide us over, and now we are pleased to announce that Mrs. Dorothy C. Williamson has accepted the appointment as permanent assistant secretary.

The financial problem of the Society has greatly concerned the Council. Raising the membership fees was not sufficient for expenses, particularly since the printing account for publications kept increasing until now the cost for this item is more than three times that of eight or ten years ago. Dr. Heard has written to each member stressing our urgent need, and he has outlined a plan, passed by the Council, to cover the emergency. We hope this will meet with a ready response and will solve our problem. Briefly, to quote from Dr. Heard's letter,

> The Council suggest two particular classes of contributors, (a) Those who contribute ten dollars or more per year, i.e., three dollars membership plus seven dollars or more donation, these to be known as sustaining members. (b) Those who contribute fifty dollars or more, i.e., three dollars membership plus forty-seven dollars or more donation, to be known as patrons.

Although a very short time has elapsed since his letter went out, it is very gratifying to notice that already a number of very generous donations have been received.

The brighter side of the picture is that without question the interest of the general public in the subject of astronomy generally and in the Society particularly is growing. This is borne out by the greater number of articles appearing in the magazines and the daily papers. The talk of space travel and even some of the comics are up to date, arousing the curiosity of children about the wonders of the heavens. Our office mail brings more than ever before requests for information, literature and maps on the subject, and many of these requests are from pupils in schools. The OBSERVER'S HANDBOOK is increasing in popularity.

Interest in the award of the Chant Medal is reviving, and we take pleasure in announcing that Mr. Jean Naubert, of 6765 St. Dominique Street, Montreal, Quebec, is the winner for 1953. He is one of the founders of the Centre Français de Montréal, and is now a Director of the centre. He has made a specialty of telescope building, "mounting his mirrors in an original and expert manner." His photography of the moon is judged to be exceptional.

The standing Nominating Committee reported to the National Council the following as candidates for Honorary Membership:

F. T. M. Stratton
Gonville and Caius College
Cambridge, England

Otto Struve
University of California
Berkeley 4, California

Walter Baade
Mt. Wilson Observatory
813 Santa Barbara St.
Pasadena 4, California

J. H. Oort
Steerewacht
Leiden, Netherlands

The National Secretary was instructed to write these nominees with the result that all expressed a great desire, considering it an honour, to be elected to Honorary Membership in the Society.

They were duly elected at the Annual Meeting.

It has been thought by the Executive of the Council that an interchange of ideas and programmes among the centres would be interesting and profitable. Some of the centres have specialized on some phases of astronomical activity with much success. To mention a few:

Montreal's observational programme is notable. Toronto's committee's experience in telescope making would be valuable if recorded. We would also like to have Hamilton's description of the use and value of their Spitz Planetarium.

It is therefore suggested that a feature article be written by one of the members of each interested centre. We think the Editor of the JOURNAL would find space to print these articles from time to time for the benefit of all the members.

REPORT OF THE LIBRARIAN

During the past year the library of the Royal Astronomical Society of Canada has been moved, along with the business office, to 13 Ross Street, Toronto 2B. The writer wishes to thank those members who assisted in the moving, and in particular Mr. W. R. Sherrick who did much to improve the new premises. Messrs. G. F. Longworth and F. Hawker of the David Dunlap Observatory are to be thanked for erecting bookshelves etc. Opportunity was taken during the move to classify that section of the library containing unbound periodicals and observatory and miscellaneous publications. A system of stacks has been introduced, and considerable meterological material has been given to the Meteorological Service of Canada on indefinite loan. Many of the older periodicals, having little to do with astronomy and having fallen into disuse, are being put up for sale.

During 1953, periodicals were sent in exchange to 131 observatories and other institutions. Much of the material received in exchange is difficult to house conveniently and is not used by any member of the Society. This material has no saleable value because of its nature and general incompleteness. Because of this and the financial position of the Society, the National Council authorized a cut in the exchange list for 1954. The writer, with the help of Miss R. J. Northcott, Assistant Editor of the Journal and Dr. H. S. Hogg, Second Vice-President of the Society, reviewed the exchange list and sent letters to 53 observatories and 25 other institutions requesting a discontinuation of any exchange and enclosing a subscription form to the Journal. Most of these 78 have already become subscribers.

Of interest to members residing or visiting in Toronto are the new library hours which are from 9:00 a.m. to 12:30 p.m. and 1:30 to 3:00 p.m. Monday to Friday. The library has also been open for half an hour following meetings of the Toronto Centre during the Fall of 1953, and this practice will be continued in 1954. It has resulted in a 100 per cent. increase in the number of books borrowed for 1953 over 1952, and a 400 per cent. increase in the number of periodicals borrowed.

There exists for centres of the Society outside Toronto a "loan by mail" service which has not been made use of in recent years. The writer is happy to recommend and send books on specific subjects if any centre so desires.

William R. Hossack, *Librarian.*

REPORTS OF SECRETARIES OF CENTRES

Ottawa Centre

Two ordinary meetings of the council were held in 1953. Six public lecture meetings took place in the National Museum Lecture Hall, as follows:

January 6—J. A. Pearce, Ph.D.: "The High Temperature Stars."
January 13—Wm. Petrie, Ph.D.: "Auroral Studies."
February 19—J. Hargreaves: "Eclipse Expedition to Africa."
March 26—Ian Halliday: "Results Obtained with the 200-inch Telescope."
April 23—A. C. Hamilton: "Surveying by Shoran."
November 30—P. L. Willmore, Ph.D.: "Volcanoes in the West Indies."

The annual dinner meeting was held December 15 in the Experimental Farm Cafeteria. More than 80 members and friends heard D. A. MacLulich, our retiring president, speak on "Flight in the Upper Atmosphere."

Following the example of the Toronto Centre, two telescopes were set up each night during the Ottawa Exhibition, and over 1500 persons viewed the moon and stars.

Since last year we have had a net gain of 5 members, the membership now standing at 87.

R. W. Tanner, *Secretary.*

Hamilton Centre

During the year 1953, seven regular meetings were held in Room H102, Hamilton Hall, McMaster University, and Field trip to the David Dunlap Observatory.

January 8—W. J. McCallion, M.A.: "The Birth of the Stars." M. W. Johns, Ph.D.: Planetarium Demonstration.
February 5—T. M. Norton: "Einstein, The Man"; F. R. Britton, B.Sc., M.A.: "Understanding Einstein."
March 5—W. J. McCallion, M.A.: "Equation of Time"; N. H. Parker, B.S., Th.M., Th.D.: "Hebrew Ideas of Astronomy."
April 2—F. Schneider: "How to make a Telescope and Observing"; Helen S. Hogg, Ph.D.: "Marvels of the Milky Way."
May 7—A visit to the David Dunlap Observatory.
October 1—W. Hossack, Ph.D.: "Radio Astronomy."
November 5—S. Kirkwood, B.Sc., M.S., Ph.D.: "Origin of Life on Earth."
December 3—N. D. Lane, Ph.D.: "Parallax." W. J. McCallion, M.A.: "What Time Is It?"

Membership—Total 71 and includes three life members.

George Murchie, *Secretary.*

Winnipeg Centre

During the year 1953, 8 regular meetings, 3 observation nights, and two Council meetings were held.

The membership was increased by 35 new members during the year, and also 12 junior members; the total stands at 64.

The accomplishment of the University's interest and support is due to the efforts of Mr. Coats, the President, who secured the interest of Dr. Gillson, University President, Mr. Lockhart, of the Department of Mathematics, and others. This close association with the University existed in the past, but was lost with the shifting of the University.

Topics dealt with at the regular meetings were as follows:

January 14—H. E. Rasmussen: "National Park Films."
February 11—Robert J. Lockhart: "Man's Debt to the Stars."
March 11—D. R. P. Coats: "Lens-Grinding and Telescope Making."
April 8—Victor Martens: "The Birth of the Earth."
October 16—Film: "Story of Palomar."
November 13—Robert J. Lockhart: Two films from the University Library: "The Gyroscope" and "The Solar Family."
December 11—D. R. P. Coats: "Sun-spot Cycles." Annual Meeting.

In addition, the Centre, in conjunction with the Department of Mathematics and Astronomy of the University, presented for the general public, a new series of Summer Observation Nights at the Fort Garry campus, well removed from city lights and "smog." With five telescopes in operation, well over 1,000 people of Winnipeg and district, as well as many visiting tourists, took advantage of the opportunity to view celestial objects during May, July, August, and September, while the transit of Mercury was observed under ideal weather conditions in November. During the autumn, the use of telescopic equipment was extended to adults enrolled in the University's Evening Institute course in Popular Astronomy.

1953 also saw the inauguration of a Monthly News Letter to all members and the establishment of a Book Corner at the public meetings.

Allan Hill, *Recorder.*

Victoria Centre

During the year 1953 the Victoria Centre held seven regular meetings:

January 14—R. M. Petrie: "Astronomy in Europe Today."
February 11—J. D. Jeys: "Nuclear Physics and Its Applications."
March 11—Mrs. J. R. Noble: "The Philosophy of Modern Astronomy."
April 8—W. G. Milne: "Earthquakes on the Pacific Coast."
October 14—P. E. Argyle: "Photoelectric Astronomy."
November 18—B. N. Moyls: "Moving Star Clusters: The Ursa Major Cluster."
December 10—N. G. Rogers: "Recent Developments in Astronomy."

The 1953 membership stands at 87 including 6 life members and 4 junior members.

In 1953 the Centre offered its twenty-second annual summer course "Summer Evenings With the Stars", to an enrolment of 199 persons. The six meetings included lectures followed by observational periods.

July 27—A. McKellar: "Learning to Know the Stars."
August 3—G. J. Odgers: "The Universe of Galaxies."
August 10—J. Stebbins: "The Stars in Their Spaces."
August 17—G. Shaw: "The Sun and His Family."
August 24—E. R. Gibson: "Mountaineering on the Moon."
August 31—Visit to the Dominion Astrophysical Observatory.

JOHN L. D. JERVIS, *Secretary-Treasurer.*

MONTREAL CENTRE

The Centre's 35th year was characterized by progress and varied activity. The important work of the Centre has continued to be its emphasis on practical observation and efforts to interest an even wider circle in astronomy and allied interests. Our Star Night and many less spectacular but important events have been well received and continue to grow.

During the 1952–53 season thirteen regular meetings of the Centre were held with an average attendance of 68 members and guests. Several of the meetings were addressed by our own members. Outside speakers included Mrs. J. H. Beardsley of Springfield, Vermont, Dr. C. S. Beals, Dominion Astronomer, Dr. W. H. Carmichael of Atomic Energy of Canada, and Dr. I. M. Rabinowitch, O.B.E., who presented his paper on the Art of Scientific Investigation.

Among our most important activities is the regular Saturday evening observing and we are most grateful to our colleague Mr. DeLisle Garneau for his continued co-operation in allowing the Centre to use his observatory.

The telescope-making class, under Mr. Robert Venor, has continued to do excellent work having produced several good telescopes each year for the past three or four years. Last year's class exhibited their telescopes at a meeting at Montreal High School at which the Planetarium was demonstrated by Miss Grace Fletcher.

The Centre is indebted to McGill University as it has been since its inception for their kind co-operation in many ways particularly in the granting permission to use the lecture theatre of the Macdonald Physics Building for regular meetings. We wish to thank the press for their support and reporting of astronomical events and all who have helped the Centre in any way are hereby officially thanked.

HENRY F. HALL, *Secretary.*

London Centre

During the year 1953 the London Centre held seven monthly meetings at the Hume-Cronyn Memorial Observatory of the University of Western Ontario. A special joint meeting with the Windsor Centre was held in London. Two meetings of the Executive Committee were held.

A feature of the regular meetings was Operation "Planet"—a planet plotting project which showed the changing positions of the planets throughout the year. This project was directed by various members of the Centre.

The membership roll consists of 32 paid members for 1953.

A schedule of meetings of the London Centre follows:

January 20—R. H. Cole, Ph.D.: "Eclipses."
Feb. 17—H. R. Kingston, Ph.D.: "Multiple Stars."
Mar. 17—H. Schoenfeld: "Origin of the Earth."
Apr. 17—J. F. Heard, Ph.D.: "An Astronomer's Pilgrimage to Rome."
May 23—Joint Meeting with Windsor Centre; O. C. Mohler, Ph.D.: "The Sun."
Oct. 20—A. Emsley: "Pilgrimage to Palomar."
Nov. 24—G. R. Magee, Ph.D.: "A Recent Revision of the Distance Scale of the Universe."
Dec. 15—Annual Meeting; G. Walden, Ph.D.: "A Review of *Stars in the Making* (Gaposchkin)."

At various times through the year, sound films were presented, entitled "The Solar Family", "The Earth in Motion", "The Moon", and "A is for the Atom", the latter being obtained through the courtesy of the Canadian General Electric, Ltd.

Members of the London Centre assisted at Monthly Open Houses conducted at the Observatory for the public.

G. R. Magee, *Secretary Treasurer.*

Vancouver Centre

There were eight regular meetings of the Vancouver Centre in 1953, all in the Physics Building at the University of British Columbia. The attendance varied from 88 to 17 and averaged about 35. The list follows.

January 13—F. A. Kaempffer, Ph.D.: "The Idea of General Relativity."
February 10—D. W. L. Smellie, M.A.: "Stellar Atmospheres."
March 10—J. B. Warren, Ph.D.: "Nuclear Astronomy."
April 14—R. J. Clark: "The Earth."
May 15—Members' Night; A. Outram: "The Morrison Planetarium"; E. M. Price: "Indoor Astronomy"; A. W. Mackenzie: "Earth Forces."
October 13—E. M. Price: "Radio Astronomy."
November 10—A. McKellar, Ph.D.: "Probing The Atmospheres of Giant Stars."
December 8—A. M. Crooker, Ph.D.: "Astronomical Spectroscopy."

The Centre did not put out telescopes on the University Grounds this

summer, but it is hoped to have some suitable instruments ready for 1954.

The Annual Dinner was at the Faculty Club on December 8. Seventeen members attended. The annual meeting for the election of officers was held just before the regular monthly meeting of that day.

Five new members joined during the year and there are now forty-one on the roll.

The Centre is very much indebted to Dr. Shrum and to the University for the use of the Physics Building.

R. J. Clark, *Secretary.*

Edmonton Centre

The regular meetings of the Edmonton Centre have been held in the Arts Building of the University of Alberta, through the kindness of the authorities. The average attendance was 30 members and visitors. Refreshments arranged by the social hostesses were much appreciated after the regular meetings. The dinner meeting was held in the banquet room of the Corona Hotel.

Handbook talks were given by Dr. Campbell, and the news talks by the Librarian, Mr. Keeping. Some short talks and reports on observing were given by Earl Milton and Frank Loehde.

The main papers were as follows:

December 11—C. R. Stelek: "Magnolias in Alberta."
January 8—L. E. Gads: "M. V. Lomonosoff."
February 12—H. Grayson-Smith: "Planetary Atmospheres."
March 12—G. K. Horton: "The Origin of the Solar System."
April 9—Miss E. Kennedy: "White Dwarfs."
May 21—E. S. Keeping, E. H. Gowan and J. W. Campbell gave an outline of Mr. Wates' life, work and interests, almost exactly ten years after the formal presentation of the Wates Telescope.
October 8—Earl Milton—"Our Cosmic Neighbours."
October 29—P. M. Millman: "An Astronomical Pilgrimage."

E. H. Gowan, *Secretary.*

Centre de Québec

La revue de l'année écoulée nous offre comme fait de premier plan à signaler un intérêt accru de la jeunesse studieuse pour l'astronomie. A quoi attribuer ces nouveaux enthousiasmes, sinon à la publication de *Notre Univers Merveilleux*? Ce volume aurait donc fort bien rempli son rôle jusqu'à maintenant, et ce sera la responsabilité de la société d'astronomie de voir à ce que ces dévouements n'en restent pas là et se matérialisent en oeuvres scientifiques.

A l'observatoire temporaire de la Tour Martello, on a noté plus d'observateurs qui s'initiaient aux travaux pratiques. Un courant s'est manifesté dans divers centres de la province, où l'on s'occupe activement de l'érection d'observatoires et du groupement des amateurs en sociétés.

Au cours de la dernière saison, l'observatoire n'a été ouvert au public que sur rendez-vous, mais cela n'a guère affecté le nombre total des visiteurs. Des huit cents que nous avons accueillis, une grande proportion étaient des élèves des écoles primaires de la ville, qui ont profité des Visites Scolaires jusqu'en fin de mai. Bien que très populaires auprès des professeurs et des élèves, ces visites n'ont pu être reprises à l'automne, faute de temps à notre disposition.

L'Académie des Sciences du Maryland nous a gratifiés, cette année encore, de son almanach-graphique du ciel, tiré à 4500 copies. C'était la neuvième année consécutive de cette publication.

PAUL-H. NADEAU, *Le Secrétaire.*

WINDSOR CENTRE

Eight regular meetings of the Society and one joint with the London Centre at London, Ontario, were held during the year. Through the courtesy of the Chief Librarian, Miss Anne Hume, the Art Gallery of the Willisted Library was made available for the Windsor meetings. Two council meetings were held at the home of the President, Mr. W. Almon Hare. The June meeting and a council meeting were held at the home of Mr. D. C. Bawtenheimer.

The average attendance at the regular meetings was 37. The total membership now stands at 42, a net gain of 7 over last year.

The main topics dealt with at the regular meetings were as follows:

January 20—E. R. Phelps, Ph.D.: "The Fundamental Causes of Weather."
February 17—Keith Pierce, Ph.D.: "Space Travel from the Viewpoint of an Astronomer."
March 17—George Carhart: "Common Misconceptions in the Field of Astronomy."
April 21—Lee F. McGee, B.A.: "Elementary Concepts of Radiant Energy."
May 23—Joint meeting with the London Centre at London, Ontario. O. C. Mohler, Ph.D.: A commentary with movies of "Sun-spots and Solar Prominences."
June 24—Charles A. Bell, Q.C.: Kodachromes of Europe and the Coronation.
September 15—D. B. McLaughlin, Ph.D.: "Time and its Evaluation."
October 20—Professor the Rev. N. J. Ruth, M.A.: "Nuclear Energy of the Sun."
November 17—Annual Meeting. Cyril B. Hallam, B.A.: A commentary on new books about Astronomy.

ROBERT C. BRADLEY, *Secretary.*

Centre Français de Montréal

Comme par le passé les réunions du Centre Français de Montréal ont eu lieu à l'Ecole Polytechnique. Les directeurs se sont réunis en séance du conseil quatre fois et les membres ont été convoqués neuf fois en séance régulière et une fois en assemblée générale, pour l'élection du conseil.

Voici la liste des séances régulières et des sujets traités:

14 janvier 1953—Frère Robert, f.e.c.: "Quelques problèmes d'astronomie."
29 janvier 1953—Jean Asselin, Ing. P.: "Le Cardinal et la Navigation."
11 février 1953—Père Marcel Lemieux, s.j.,: La Cosmogonie au temps des Hébreux."
11 mars 1953—Dr. A. D. Tessier: "Chaleur et Lumière."
25 mars 1953—Gaston Lebrun: "Le Calendrier."
8 avril 1953—Père Frédéric-Marie Bergounioux, o.f.m.: "Quelques problèmes de l'évolution."
29 avril 1953—Frère Robert, f.e.c.: "Une anticipation d'Einstein."
16 juin 1953—Sur invitation de Mlle. Marcelle Gauvreau, l'un de nos directeurs, réunion conjointe de la Société d'Histoire Naturelle et du Centre Français de Montréal au Jardin Botanique. Visite des jardins dirigée par Mlle. Gauvreau—Explications et observation du ciel par Mme. Hall, MM. DeLisle Garneau et J. E. Guimont.
30 septembre 1953—Reprise des activités et séance de cinéma: "The Story of the Telescope," "On to Jupiter," "Explorons l'Univers" et "The Earth's Rusty Crust."
14 octobre 1953—Soirée au Collège Mont-St-Louis dirigée par le frère Robert, f.e.c. Lecture d'articles devant paraître dans "La Patrie" sous la rubrique de "LAstronomie du dimanche" préparés par le frère Robert-Saynette tirée du Petit Prince de St-Exupéry et des extraits du livre de Job par des élèves et professeurs du Conservatoire LaSalle.
18 novembre 1953—Professeur René Robert, Ing.P.: "d'Où viennent les rayons cosmiques."
16 décembre 1953—Gaston Lebrun: "L'Etoile de Béthléem." Explication du ciel d'hiver: Jean Asselin, Ing.P.

Il y eut de plus, au cours des mois de julliet et août, des séances d'observation à l'Observatoire Ville-Marie. Ces séances furent dirigées par MM. DeLisle Garneau, Jean Asselin et Gaston Lebrun.

F. Laforest, *secrétaire-trésorier.*

FINANCIAL STATEMENT, 1953

I. NATIONAL TREASURER

GENERAL ACCOUNT

Receipts		Disbursements	
Grant from Government of Canada	$ 3,000.00	Deficit from 1952	$ 629.65
Grant from Province of Ontario	500.00	Publications	7,862.46
Fees from Centres	3,421.80	Grants to Centres	1,114.25
Fees from general members	720.79	Salaries	1,712.50
Subscriptions to the Journal	550.16	Rent and Light	686.83
Sale of Observer's Handbooks	1,319.81	Office expenses, postage, etc.	258.12
Sale of Publications and Reprints	2,231.96	Printing and stationery	220.12
Advertising	257.00	Stencils	27.51
Bond interest transferred from Life Membership Fund	51.00	Annual At-Home	101.50
Donations and Miscellaneous Contributions	40.80	Moving and general expenses	159.20
		Bank charges and exchange	73.29
		Total	$ 12,215.78
Total	$12,093.32	Deficit carried forward	$ 752.11

LIFE MEMBERSHIP FUND

Receipts		Disbursements	
Balance—January 1, 1953	$ 2,107.66	Bond interest to General Acc't	$ 51.00
New Life Members admitted during year (4)	160.00	Balance—December 31, 1953	$ 2,267.66
Bond interest	51.00		
Totals	$ 2,318.66		$2,318.66

BUILDING FUND

Balance—January 1, 1953	$ 7,746.93		
Bond interest	207.00		
		Balance—December 31, 1953	$ 7,953.93

SOUTHAM PRESS FUND

Receipts		Disbursements	
Balance—January 1, 1953	$ 1,840.25	Bank charges	$ 12.05
Bond interest	41.50	Balance—December 31, 1953	$ 1,869.70
Totals	$ 1,881.75	Totals	$1,881.75

J. H. Horning, *National Treasurer.*

II. REPORTS OF TREASURERS OF CENTRES

TORONTO CENTRE

Receipts		Disbursements	
Balance from 1952	$ 429.00	Fees to National Treasurer	$1,144.50
Members' fees	1,144.50	Donation to National Treasurer	18.50
Grant from National Council	334.00	Printing and postage	105.47
Bank interest	15.78	Rentals for rooms and projector	66.37
Donation	5.00	Expenses of speakers	20.00
Donation to National Society	18.50	Balance	591.94
Totals	$1,946.78	Totals	$1,946.78

Special Purpose Fund

Receipts		Disbursements	
Balance from 1952	$ 794.91	Printing for Hobby Show	$ 10.09
		Balance	784.82
Totals	$ 794.91	Totals	$ 794.91

J. B. Wallace, *Treasurer.*

OTTAWA CENTRE

Receipts		Disbursements	
Balance from 1952	$ 80.43	Fees to National Treasurer	$252.00
Members' fees	252.00	Printing, postage, and stationery	36.24
Grant from National Council	76.00	Expenses *re* meetings	197.05
Donations	10.00	Cost of Handbooks	12.00
Sale of Handbooks	27.50	Insurance	11.55
Donation by Central Canada Exhibition for astronomical service	50.00	Miscellaneous	1.20
		Balance carried forward	109.39
Proceeds of Annual Dinner	123.00		
Bank interest	.50		
Totals	$619.43	Totals	$619.43

S. A. Mott, *Treasurer.*

HAMILTON CENTRE

Receipts		Disbursements	
Balance from 1952	$148.15	Rent	$ 47.59
Members' fees	234.00	Fees to National Treasurer	204.00
Grant from National Council	59.00	Stationery	8.04
Donations	2.00	Postage	20.00
Bank interest	0.87	Printing	18.60
Refund	2.24	Expenses *re* meetings	9.43
		Exchange on cheques	0.33
		Balance carried forward	138.27
Totals	$446.26	Totals	$446.26

GEORGE MURCHIE, *Treasurer.*

WINNIPEG CENTRE

Receipts		Disbursements	
Balance from 1952	$157.96	Fees to National Treasurer	$139.00
Members' fees	199.00	Stationery	2.75
Grant from National Council	29.00	Postage	11.00
Donations	10.00	Expenses *re* meetings	15.12
Bank interest	0.78	Miscellaneous	8.00
Handbook and Journals	2.00	Balance carried forward	222.87
Totals	$398.74	Totals	$398.74

MARGARET E. WALTERSON, *Treasurer.*

VICTORIA CENTRE

Receipts		Disbursements	
Balance from 1952	$217.45	Rent	$ 36.00
Members' fees	285.00	Fees to National Treasurer	205.65
Grant from National Council	101.67	Stationery	18.36
Bank interest	0.60	Postage	4.76
Miscellaneous	28.78	Printing and Advertising	16.96
		Expenses *re* meetings	12.34
		Exchange on cheques	1.18
		Miscellaneous	50.36
		F. S. Hogg Memorial Fund	50.00
		Travelling Expenses	12.00
		Balance carried forward	225.89
Totals	$633.50	Totals	$633.50

JOHN L. D. JERVIS, *Treasurer.*

MONTREAL CENTRE

Receipts		Disbursements	
Balance from 1952	$ 355.15	Fees to National Treasurer	$ 753.00
Members' fees 1952	6.00	Postage	97.00
1953	744.00	Stationery	77.22
1954	3.00	Rent	79.00
Donations—Library	2.00	Expenses *re* meetings	5.10
General Funds	253.43	Library	40.06
Grant from National Council	241.00	Equipment	21.22
Bank interest	3.81	Dues—Film Council	5.00
		Insurance	32.35
		Exchange on Cheques	1.90
		Expenses *re* Star Night	16.60
		Balance carried forward	479.94
Totals	$1,608.39	Totals	$1,608.39

Observatory Fund

Receipts		Disbursements	
Balance from 1952	$248.57	Bank charges	$ 1.00
Donations	192.22	Balance carried forward	
Interest on bonds	3.00	Dom. of Canada Bonds	100.00
Bank interest	1.72	Cash in Bank	344.51
Totals	$445.51	Totals	$445.51

C. N. S. Yarnell, *Treasurer.*

LONDON CENTRE

Receipts		Disbursements	
Balance from 1952	$ 27.47	Fees to National Treasurer	$ 99.00
Members' fees 1952	3.00	Expense *re* meetings	49.95
1953	90.00	Exchange on cheques	0.42
Grant from National Council	28.00	Balance carried forward	2.16
Donations	3.00		
Bank Interest	0.06		
Totals	$151.53	Totals	$151.53

G. R. Magee, *Treasurer.*

VANCOUVER CENTRE

Receipts		Disbursements	
Balance from 1952	$ 41.72	Fees to National Treasurer	$149.00
Members' fees	149.00	Stationery	0.31
Grant from National Council	27.00	Postage	7.80
Bank interest	0.95	Expense *re* meetings	12.00
		Exchange on cheques	0.30
		Balance carried forward	49.26
Totals	$218.67	Totals	$218.67

CAROLINE A. ROGERS, *Treasurer.*

EDMONTON CENTRE

Receipts		Disbursements	
Balance from 1952	$104.00	Fees to National Treasurer	$150.00
Members' fees	198.00	Stationery	2.60
Associates' fees	3.50	Postage	21.50
Grant from National Council	62.33	Printing	7.68
Refund (adjustment)	2.25	Expenses *re* meetings	11.77
Bank interest	2.70	Exchange on cheques	0.25
		Miscellaneous	5.62
		Balance carried forward	173.36
Totals	$372.78	Totals	$372.78

H. J. MONTGOMERY, *Treasurer.*

QUEBEC CENTRE

Receipts		Disbursements	
Balance from 1952	$121.64	Fees to National Treasurer	$177.00
Members' fees	192.10	Stationery	9.82
Grant from National Council	67.00	Postage	13.00
Grant 1952 Provincial Government	300.00	Printing	17.04
		Exchange on cheques	0.13
Grant 1953 Provincial Government	300.00	Miscellaneous	9.17
		Observatory	40.81
Miscellaneous	3.52	Loan N.U.M.	300.00
		Balance carried forward	417.29
Totals	$984.26	Totals	$984.26

PAUL-H. NADEAU, *Treasurer.*

WINDSOR CENTRE

Receipts		Disbursements	
Balance from 1952	$ 46.75	Fees to National Treasurer	$129.00
Members' fees	123.00	Miscellaneous	5.80
Grant from National Council	35.00	Expense *re* meetings	10.00
Donations	27.00	Balance carried forward	87.37
Bank interest	0.42		
Totals	$232.17	Totals	$232.17

W. J. Person, *Treasurer.*

CENTRE FRANÇAIS DE MONTREAL

Receipts		Disbursements	
Balance from 1952	$ 38.80	Rent	$ 16.00
Members' fees	162.00	Fees to National Treasurer	162.00
Grant from National Council	51.75	Stationery	10.28
Donations	113.00	Postage	16.64
Bank interest	2.19	Expense *re* meetings	34.38
		Exchange on cheques	0.25
		Miscellaneous	18.50
		Subscription to magazine	5.30
		Balance carried forward	103.89
Totals	$367.74	Totals	$367.74

Fleurange Laforest, *Treasurer.*

The Royal Astronomical Society of Canada

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NOTES FROM OBSERVATORIES

Dominion Observatory, Ottawa

Results of meridian circle observations taken between 1935 and 1950, containing 1525 stars, have been completed and are being prepared for publication. The current programme of zenith stars for Ottawa, Washington, Richmond, Florida, and Greenwich, is drawing to a close. A new programme of approximately 3000 stars, comprising all FK3 stars from $-27°30'$ will be started in 1954.

Ottawa zenith star positions have been improved by combining results from both the meridian circle and the photographic zenith tube (P.Z.T.). Latitude, as measured by the P.Z.T., reached a maximum of $45°23'38''.93$ in August 1952, a minimum of $38''.12$ in May 1953, and a maximum again of $39''.00$ in September 1953. Canadian Time signals, CHU, radiating on 3330, 7335, and 14670 kilocycles are soon to be provided with a voice announcement each minute by the addition of a talking clock. Mean time quartz crystal clocks are used both as primary timekeepers and as time signal control clocks.

Successful visual and photographic observations of the Perseid meteor shower of 1953 were carried out in Ottawa with simultaneous radar observations by the National Research Council. The most interesting result was an infra-red spectrum which showed atmospheric lines of nitrogen and oxygen. This result was made possible through a recent increase in the speed of the Kodak infra-red emulsion.

During the past several years, the seismology division has been applying a method by which the direction of faulting in large earthquakes may be determined. In order to apply the method to deep focus earthquakes, and make as much use as possible of the information contained in seismograms, a large number of tables analogous to map projection tables have been prepared. Some 40 earthquakes have been successfully analyzed, and the method is being pursued with the intention of throwing light on the forces causing island arcs and mountain ranges in the circum-Pacific area.

An intensive geophysical study was made of a circular topographical feature near Gilmore Lake, Ontario, to determine the possibility of meteoric origin. Gravity, magnetic, and seismic surveys were conducted over the area, the results of which are being analyzed.

The project of establishing a series of precise pendulum stations from Mexico City to Fairbanks, Alaska, was completed, and a consistent set of results obtained which should be extremely useful in adjusting all gravity measures in North America to a uniform basis. Pendulum ties were completed between the national gravity base stations at Ottawa, Washington, D.C., and the National Physics Laboratory, Teddington, England. Two gravity parties were engaged during the summer in extending the gravimeter base network of Canada.

The first airborne magnetic survey with the recently completed Dominion Observatory Universal Magnetometer was made between September 4th and 14th, 1953. A flight of 15,000 miles, requiring 77 hours 15 minutes, including each of the provinces, the North-west Territories and the principal arctic islands, provided a continuous independent measurement of declination, horizontal, and vertical force. Calibration swings were made over Meanook and Agincourt magnetic observatories. Preliminary computations indicate that the gyro stabilized platform was steady to three minutes of arc under good flight conditions. This type of magnetometer should prove most useful for rapid and accurate surveys, particularly over water and across difficult terrain.

Dr. R. de'E. Atkinson paid a three day visit to Ottawa in November and discussed in particular the design for a Mirror Transit (see *R.A.S., M.N.*, 107, p. 291). Dr. Peter M. Millman went to Albuquerque, New Mexico, to participate in a conference on Motions in the Upper Atmosphere, which was supported by the National Science Foundation. Advantage was taken to visit many of the observatories in the western United States. Mr. Dennis Corness, graduate of the University of Alberta, has joined the Stellar Physics Division for duty with the Super Schmidt installation at Meanook, Alberta. Mr. George Brealey is transferring from Meanook to Position Astronomy at Ottawa. Mr. W. S. McClenahan attended a conference in September on Problems in Astrometry at Evanston, Ill., supported jointly by the National Science Foundation and Northwestern University. The conference was attended by prominent astronomers of the United States, and had international representation in the persons of the Astronomer Royal, Sir Harold Spencer Jones, Dr. A. Danjon of Paris, Dr. O. Heckmann of Hamburger Sternwarte, and Dr. R. H. Stoy, Royal Observatory, Cape of Good Hope.

Mr. L. G. D. Thompson at Western University, London, Ontario, Malcolm M. Thomson at Yale, and Ronald Niblett at Cambridge, England, are all on educational leave. Two staff members have recently become married, Dr. Kenneth Whitham and Mr. J. L. Roy.

VARIABLE STAR NOTES

American Association of Variable Star Observers

By MARGARET W. MAYALL, *Recorder*

THE A.A.V.S.O. is comfortably settled in its new and attractive headquarters in the heart of Harvard Square, Cambridge. It was fortunate that ample space comparable to that previously occupied could be obtained in a modern building, and within the means of the association. In many ways the present location makes for a more orderly arrangement of the working material.

The Charles Y. McAteer library takes about 350 feet of shelf space, and occupies one entire side of the room, from floor to ceiling. Here for the first time our library is properly sorted and in one place. This new arrangement adds to the pleasantness of the office and will be useful to those who come there to work and use the library.

All of our files, both past and present, stretch along the wall opposite the library. The office is a comfortable place in which to work, with ample light, and conveniently located. Everything is being done to streamline the activities of the A.A.V.S.O., thereby making it possible to carry on its work more efficiently, and serve better the ever-increasing demands upon its facilities.

The Solar Division has been reorganized, and is again active in all of its programmes. The Bulletin is being published under the editorship of Harry L. Bondy, with an editorial advisory committee of Neal J. Heines, Margaret W. Mayall, William A. Reid, David W. Rosebrugh, and Alan H. Shapley. The reduction work for the determination of the American Sun-spot Numbers is being done by Mr. Rosebrugh.

A cordial invitation is extended to all astronomers and other friends to visit our new headquarters whenever they are in or near Boston. For those who have not yet received a change of address, please make a note of it: A.A.V.S.O., 4 Brattle Street, Cambridge 38, Massachusetts, U.S.A.

The financial needs of the A.A.V.S.O. are growing if it is to provide service commensurate with its increasing demands. The association is fortunate in receiving a grant-in-aid from the National Science Foundation for the current year 1954. The first step in raising the required endowment fund of $500,000 has been taken. Contributions are being received and all members are being solicited. Present contributions from business, members, and friends indicate that our first appeal for $250,000 in 1954 is not unobtainable. We hope that all members will continue to work for the fund, beyond their own immediate group. Those who wish to contribute to basic research, but who are not members, may do so by mailing checks, payable to the A.A.V.S.O. Endowment Fund, to the Treasurer at the headquarters in Cambridge.

SS Cygni 213843. The famous variable star SS Cygni showed more than usual activity during the year 1953. Eight maxima were observed, and once again, as in past years, we can be sure that no maximum was missed. In the course of the year, 1,101 observations were made by the observers on 307 nights. Included in this are 258 observations made by 10 members of the Scandinavian Astronomical Society, and sent to us by Dr. Axel V. Nielsen.

Figure I shows the light curve plotted from the daily means of all observations made during the year. The individual points are means of from 1 to 14 observations each. The numbers of the maxima are a continuation of the 1952 maxima as shown in the light curve for 1952, printed in these notes in April 1953. (This JOURNAL, vol. 47, no. 3, p. 117). The observed maxima are listed in Table I. Successive columns are: (1) number of the maximum, counting from the first maximum after discovery in 1896; (2) type according to Leon Campbell's classification; (3) Julian Day for magnitude 10.0 on the increasing branch of the curve; (4) number of days elapsed since the same point at the preceding maximum; (5) Julian Day of maximum; (6) number of days elapsed since preceding maximum; (7) Julian Day for magnitude 10.0 on the decreasing branch of the curve; (8) number of days since same point at preceding maximum; and (9) the maximum mean magnitude.

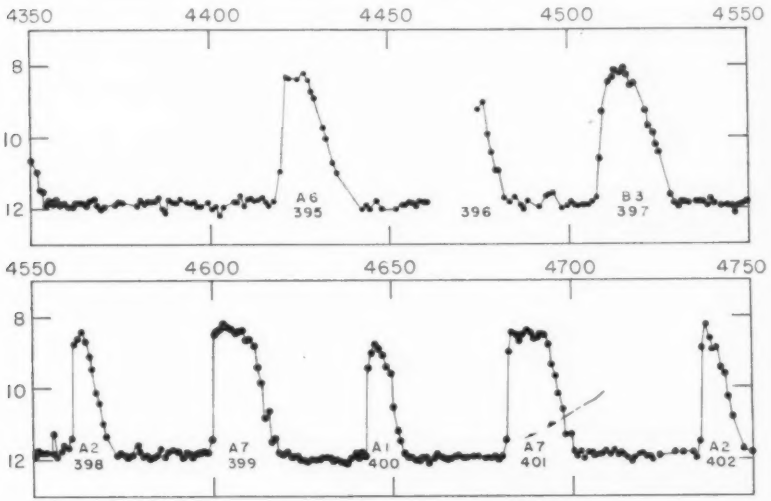

FIG. 1—Light curve of SS Cygni 213843.

TABLE I

OBSERVED MAXIMA OF SS CYGNI

No. Max.	Type	10.0 I J.D.	Diff.	Max. J.D.	Diff.	10.0 D J.D.	Diff.	Max. Mag.
395	A6	2434420	85	2434424	84	2434432	83	8.3
396	?	?	..	?	..	4478	46	?
397	B3	4508	..	4514	..	4522	44	8.1
398	A2	4561	53	4563	49	4567	45	8.4
399	A7	4600	39	4604	41	4614	47	8.2
400	A1	4643	43	4645	41	4650	36	8.8
401	A7	4682	39	4687	42	4696	46	8.4
402	A2	4736	54	4737	50	4743	47	8.2

Maximum number 396 occurred some time during the last of March or the first of April, but we received no observations until April 7, when the variable was definitely beginning to fade. Not enough observations were made to determine the type of maximum.

The mean interval between maxima of SS Cygni in 1953 is 49.6 days, considerably less than the mean interval of 52.0 days since the discovery of the variable.

Observations received during December 1953 and January 1954: During December 4,196 observations were received and in January 3,804, making a total of 8,000 from 60 observers, as follows:

Observer	December		January		Observer	December		January	
	No. Var.	No. Ests.	No. Var.	No. Ests.		No. Var.	No. Ests.	No. Var.	No. Ests.
Abbey, Leonard B.	..	..	3	11	Howarth, Mark	21	40	..	..
Adams, Robert M.	71	209	69	143	Kastin, Harold	13	47	17	66
Ahnert, Paul	..	..	5	205	Kelly, Frank J.	13	13	..	..
Alvarez, Hector	3	3	6	7	de Kock, Reg. P.	141	737	129	553
Ancarani, Mario	..	..	26	48	Kuenzi, Edward W.	10	21	..	..
Anderson, Curtis E.	78	123	54	101	Lizotte, Eugene A.	9	9	..	..
Aronowitz, Charles	38	123	54	225	Lonak, Eugene M.	..	..	3	18
Behar	3	5	..	..	Maran, Stephen	6	19	18	65
Beidler, Herbert B.	11	15	11	11	Mebius, William G.	2	2	..	..
Botham, John H.	..	..	21	49	Miller, William A.	..	..	5	9
Boutell, Hugh G.	7	30	6	14	Montague, Allen C.	12	12	14	19
Buckstaff, Ralph N.	14	25	1	1	Oravec, Edward G.	89	187	107	385
Calothy	1	1	..	..	O'Sullivan, Wm. H.	11	15	16	35
Carpenter, Claude B.	92	121	78	78	Overbeek, Michiel D.	..	..	72	142
Chandra, Radha G.	67	70	..	..	Parker, P. O.	..	..	16	16
Chester, Bryant	10	10	10	10	Parko, Joseph E.	4	4	..	..
Cragg, Thomas A.	131	150	42	43	Pearcy, Robert E.	5	5	..	..
Darsenius, Gunnar O.	37	156	23	57	Peltier, Leslie C.	47	120	38	99
Diedrich, DeLorne	2	2	3	4	Rizzo, Patrick V.	42	82	48	97
Diedrich, George	4	6	3	6	Rosebrugh, David W.	15	53	16	101
Elias, Demetrius P.	105	491	..	..	Royer, Ronald	4	15	8	18
Escalante, Francisco	..	..	59	82	Ruiz, John J.	1	101	..	..
Estremadoyro, G.A.	..	..	2	2	Semos, Elias B.	3	7	..	..
Estremadoyro, V.A.	..	..	3	3	Smits, Peter	..	..	21	30
Fernald, Cyrus F.	251	475	242	369	Taboada, Domingo	144	251	137	250
Ficonetti, Rene	18	25	..	..	Thomas, Morgan A.	..	..	4	9
Ford, Clinton B.	146	150	73	74	Venter, S. C.	..	..	63	151
Gaustad, John	8	8	15	15	Wallner, E. P.	2	25	..	..
Hartmann, F.	143	146	130	131	Weitzenhoffer, Ken.	8	11	..	..
Herring, Alika K.	12	17	..	..	Wyckoff, Jerome	34	59	40	52

Nova Search Programme: During the months of December 1953 and January 1954, reports were received from the following seven observers. Listed for each observer is the month the observations were received, the areas observed (in italics), the number of nights the region was checked, and finally, the limiting magnitude.

ADAMS, ROBERT M., Dec.–*1, 2, 16, 17*: 3, 8; Jan.–*1, 2, 17, 64*: 2, 8.

DARSENIUS, GUNNAR O., Dec.–*Dome*: 1, 2; *16, 17*: 3, 6; Jan.–*16, 17*: 2, 6.

°DIEDRICH, DELORNE, Dec.–*40*: 1, 6; *40, 94*: 1, 5; Jan.–*Dome*: 1, 2; *40*: 2, 6; *94*: 1, 6.

°DIEDRICH, GEORGE, Dec.–*56*: 1, 5; *78*: 3, 6; Jan.–*Dome*: 2, 2; *56*: 3, 6; *78*: 2, 6.

°RICK, LOUIS, Dec.–*Dome*: 3, 2; *18*: 3, 5; *63*: 1, 5; *63*: 2, 4; *65*: 2, 5; *65*: 1, 4; Jan.–*Dome*: 2, 2; *Dome*: 2, 1; *18*: 5, 5; *18*: 1, 4; *63*: 2, 5; *65*: 6, 5.

ROSEBRUGH, DAVID W., Dec.–*Dome*: 3, 3; *1, 34*: 3, 4; Jan.–*Dome*: 7, 3; *Dome*: 1, 2; *1*: 6, 4; *1*: 2, 3; *34*: 7, 4; *34*: 1, 3.

SMITH, FRANKLIN W., Dec.–*3, 4*: 6, 6; Jan.–*3, 4*: 10, 6.

°Black River Astronomical Society

4 Brattle Street
Cambridge 38, Massachusetts
February, 1954

OUT OF OLD BOOKS

By Helen Sawyer Hogg

Pons-Brooks Comet

Announcements of the return of Pons-Brooks comet, 1884I, are appearing in various astronomical periodicals and the Harvard Announcement Cards. Our readers may be interested in some of the past history of this comet. The present return is only the second one since its discovery in 1812.

This comet is one of the 36 or 37 which were found by Jean Louis Pons, who broke all records for comet discovery. Many of his comets were of course found independently by other observers. Pons seems to have had more skill in discovering comets than in measuring accurate positions for them, and for some of his comets good orbits could not be derived.

However, for this comet, which Pons found on the 20th of July in Lynx, Encke worked out an excellent orbit, with elliptical elements and a period of 70.68 years. The comet passed perihelion Sept. 15, 1812 and was visible to the unaided eye for three months. It is a member of Neptune's family, of which at least nine members are known, including the famous Halley's.

After its 1812 appearance, the next person to see it was Prof. William R. Brooks of Phelps, N.Y. Brooks was one of the great comet observers on this continent during the latter part of the last century, along with Barnard, Perrine and Swift, each of whom discovered more than ten comets. We have had occasion previously in this column to refer to the work of Brooks on telescopic meteors (this Journal, May-June, 1946). We are indebted to Mr. Howard A. Scheer of Newark, N.Y. for sending us pictures of the sites where Brooks' comet work was done. Of his earlier observing station, nothing remains, but this work led to the erection of the Smith Observatory at Hobart College, Geneva, N.Y., of which he was director until his death, and the picture of which is reproduced here. A New York State highway marker commemorates Brooks' work.

According to Chambers, "Handbook of Astronomy," 4th edition, vol. I, page 435, Brooks was looking for the return of Pons' comet by the aid of an ephemeris computed by Schulhof and Bossert. The announcement of the new comet in the *Sidereal Messenger*, vol. II, 1883, page 220 does not give this impression, and the first four sets of elements accompanying

FIG. 1—Smith Observatory, Hobart College, Geneva, N.Y., as seen from residence of Prof. William R. Brooks.

the announcement, from Harvard, Palissa, Boss, and Wilson of Cincinnati, are not the same as those of Pons' comet.

We quote from the *Sidereal Messenger*, op. cit.

EDITORIAL NOTES

A very faint telescopic comet was discovered September 1st by Prof. William R. Brooks, Phelps, N.Y. It has the appearance of a nebulous mass, a little brighter at the center and with indefinite outlines. It is now about three hundred millions of miles from the *Earth* and about the same distance from the *Sun*, and slowly approaching both. The discovery is a remarkable one in view of its great distance and faintness when first seen. We are not aware that the history of astronomy furnishes a parallel in these particulars. If computation at hand be trusted, the comet will not reach the perihelion of its orbit before May, 1884, at which time its brightness will be about one hundred times as great as it now is.

By a *Science Observer* circular we are favored with the following elements and ephemeris:

The four different sets of elements are followed by a subsequent communication in which Lewis Boss identifies Brooks' comet with that of Pons.

Under date of September 21, Professor Lewis Boss, Director of Dudley Observatory, Albany, N.Y., kindly sends the following:

Comet *b* 1883 (Brooks).

By means of observations secured at the Dudley Observatory on September 5th, 9th and 18th, I derived on the 19th the following parabolic elements marked I. The remarkable similarity of these elements to those given by Schulhof and Bossert for the Pons comet of 1812 pointed unmistakably to their identity. The elliptic elements of the Pons comet (here marked II) are transcribed from the memoir of Schulhof and Bossert (p. 150), except that they are reduced to the mean ecliptic and equinox of 1883.0, and a value of T derived from the observations of the present apparition.

I		II	
T	1884 January 25.788 (G.M.T.)	T	1884 January 25.699 (G.M.T.)
Node	254° 13′.6		254° 8′.8
Node to Perihelion	199 14.4		199 12.9
Inclination	74 47.1		74 03.3
log. q	9.87944	log. q	9.88930
	Eccentricity 0.95527		

It is remarkable that the present comet should have been picked up when its light ratio was six times as small as it was at discovery in 1812. It was then regarded as a faint object. Were it not for the overwhelming testimony from other sources, one might doubt, on the ground of brightness, the identity between the present comet and that of 1812. – – –

The identity of the Pons comet of 1812 with comet *b*, 1883, was announced in an "Associated press" dispatch from the Dudley Observatory on the evening of September 19.

The astronomical periodicals of late 1883 and early 1884 contain many interesting descriptions, accounts and drawings of this comet, which was remarkable for its changes in brightness and shape. Among other observations are those of its transit over a bright star, in *Sidereal Messenger,* vol. III, 1884, page 118, from which we quote.

TRANSIT OF THE PONS' COMET OVER A BRIGHT STAR

The passage or transit of a large comet over a large star is an event which very rarely occurs, and if, as in the present case, the comet be moving rapidly, the chances of any one observing it during the very brief interval of transit (in this case only two or three minutes) are extremely small. It is therefore a matter of some interest to preserve a carefully recorded instance of the kind. – – –

Early in the evening of the 24th inst. I found Pons' comet close to a star in *Cygnus* of the seventh magnitude, and from its relative position could see, at a glance, that a transit was inevitable. As I had been for three months watching this very comet for such an opportunity, I hurried my preparations, putting on a power of 100 and getting an assistant to mark time. The following are the results: – – – Star began to fade at $6^h31^m42^s$ local time; star began to brighten at $6^h35^m22^s$; interval 3^m40^s; – – –

I am very sensible that it would be unsafe to state, in positive terms, that the star and the centre of the nucleus coincided; but to all appearances, the central line of passage was through the star; yet I found it impossible to see the stellar centre of the comet in contact with the star on either side, and there was an interval corresponding with the waning of the star's light, when the nucleus was invisible. The star is an orange-tinted star, about 30^m south following ϵ *Cygni*, and faded by estimation half a magnitude.

If Pons comet, then, has a solid or liquid core, it cannot well be over two hundred miles in diameter, while the inference is, that it is, like many other comets, a gaseous body throughout, although to-night (December 27th), it shows a well-defined planetary disc, which, I must think, would obliterate an ordinary star. The tail (about 2° long) however, is diaphanous to stars down to the 13th and 14th magnitudes, even up to the circular nebulosity which surrounds the head. – – – *Beta, in Times-Union* (111).

The present return of Comet Pons-Brooks was heralded by Dr. Paul Herget of the Cincinnati Observatory in February 1952 (Harvard Announcement Card 1166). The comet was apparently not found however until June 20, 1953 when it was recovered by Miss Elizabeth Roemer on Lick photographs, as a 17th magnitude object in Draco. (We may be pardoned for remarking that Aquarius would have been more appropriate). The comet will come to perihelion May 22 this year, five days earlier than had been expected. It is east of the sun and north of it through April and part of May, when it may have naked eye visibility. Unfortunately it is so close to the sun that this is classed as a poor return of this particular comet.

NOTES AND QUERIES

New Publication on Meteoritics

From the time of the inception of the Meteoritical Society in 1933, its *Notes* and *Contributions* were published regularly in the monthly magazine, *Popular Astronomy*, until December 1951, when that periodical was discontinued on the completion of its 59th volume. By arrangement with the University of New Mexico and by unanimous vote of the Council of the Society, a new publication entitled *Meteoritics: The Journal of the Meteoritical Society and the Institute of Meteoritics of the University of New Mexico* was established, and its premier issue, consisting of 25 items and 123 pages, appeared in December 1953, as volume 1, number 1, whole number 1, 1953.

Meteoritics is to be issued at least once but not more than four times a year. It is expected that eventually the journal will become a quarterly. Each volume is intended to contain from 240 to 360 pages. The Editor of the Meteoritical Society, Dr. Frederick C. Leonard of the University of California, Los Angeles, is the Editor of *Meteoritics*, and the Director of the Institute of Meteoritics of the University of New Mexico, Dr. Lincoln LaPaz, is the Associate Editor.

The annual subscription price of *Meteoritics*, to both members and non-members of the Meteoritical Society, is $4.00 (or, to student members, $2.00), regardless of the number of issues published. Orders for subscriptions should be sent to the Secretary of the Meteoritical Society, Dr. John A. Russell, Department of Astronomy, University of Southern California, Los Angeles 7, California.

Frederick C. Leonard

New Distance to Messier 81

The Mount Wilson and Palomar Observatories are working on a programme of re-determining the distances of the nearer extra-galactic nebulae. The programme was started by the late Dr. Edwin P. Hubble in 1949 when the 200-inch telescope went into operation. The first step was completed over a year ago by Dr. Walter Baade (this Journal, vol. 47, p. 174, 1953). He re-determined the absolute magnitude of the Cepheid variables, which are the most commonly used distance indicators. This led to a new determination of the distance of the Andromeda Nebula, M31, which was double the original value. This was a fundamental correction to the distance scale for it must be applied to all nebulae whose distance depends on the use of Cepheids.

The latest work, reported by Dr. Allan R. Sandage at the Christmas meeting of the American Astronomical Society at Nashville, Tenn., indicates that still another kind of correction may be necessary. This new correction, found in work on the spiral nebula M81 in Ursa Major, arises primarily from new measurements of apparent magnitudes. He used three types of stars as distance indicators, Cepheid variables, irregular variables and novae. The three indicators gave slightly different values for the distance of the spiral, but indicated a correction of about four to the value determined over fifteen years ago.

According to Sandage this factor of four applies only to the distance of M81, and does not apply to other galaxies. He pointed out that corrections for errors in apparent magnitudes may be necessary for other galaxies, but that many observations of other nebulae are needed before any general effect on the scale of the universe can be established.

R. J. N.

More Work for the Asteroids

Asteroids whose orbits are well determined may be quite useful in solving problems of fundamental observational astronomy, and those who read Notes and Queries in this Journal, vol. 47, p. 259, 1953, will recall that the motion of the asteroid Icarus was used as an independent check of the theory of relativity. Some of the asteroids that have come closest to the earth have been used to determine the distances between the various planets in our solar system. Another problem in which they are used is in locating accurately the position of the ecliptic, the plane in which the earth travels about the sun. In the past, major planets have been used for this, but they present such noticeable disks when viewed through a telescope, that their positions are difficult to determine accurately. But a minor planet shows only a point of light even in a large telescope, and it has no atmosphere to make its outline blurred, another

difficulty with the major planets. Still another advantage an asteroid has in this work is that it is about the same brightness as the background stars with which its position is being compared, and position observations are more precise when objects of nearly the same magnitude are being compared.

It now appears that asteroids rather than major planets should be used in the study of such basic characteristics of our solar system and of the earth's own motion as the precession of the equinoxes and the obliquity of the ecliptic.

B. R. C.

Cause of Changes in Length of Day

Two scientists at the University of California, Dr. Yale Mintz of the department of meteorology and Dr. Walter Munk of the Scripps Institute of Oceanography have accumulated evidence that the winds and tides are responsible for small seasonal changes in the length of day. The observed effect is only a thousandth of a second, with the days shorter towards the end of June and longer towards the end of March.

The main contribution comes from the winds; at certain times of year westerly winds speed up the earth's rotation, and at other times easterly winds slow it down. The effect of tides causes a distortion of the entire earth, not just the oceans, and depends on the declination of the sun. When the sun is in the plane of the equator (declination zero) it causes a slight bulge on the earth directly under it which slows down the earth by a trifle. When the sun gets nearer one of the poles (declination $\pm$ 23½°), the earth rotates a little faster.

R. J. N.

The Astronomer's Prayer

Thou who canst' guide the wandering Star
Through constellations near or far,
O! calm this elemental war
Give us peace from Pole to Pole.

Thou who in wisdom placed us here
As when Thy wish can take us hence,
But whilst we tread this earthly sphere
Give us Thy wide defence.

To our Creator there we call
Whatever friend or foe betide,
Should we rise or fall
In Thy protection we confide.

Samuel T. Butler

SOCIETY'S ADDRESS: 13 ROSS STREET, TORONTO 2B

Readers of this JOURNAL may have noticed that the address of the Society has been changed from 15 to 13 Ross Street. This came about as a result of the Society now having its own entrance to the street, and being granted its own number by the postal authorities.

THE EDITORS

MEETINGS OF THE SOCIETY

AT VICTORIA

January 14, 1953—The meeting, held as usual in the Normal School auditorium, was called to order at 8:05 p.m. by the president Mr. R. S. Evans. After the business had been disposed of, Mr. R. Peters spoke on the current astronomical phenomena and Mr. J. Jervis gave a short report on photographing the centre of our Galaxy. Then the speaker of the evening, Dr. R. M. Petrie, director of the Dominion Astrophysical Observatory, was introduced. Dr. Petrie spoke on "Astronomy in Europe Today". He gave an informal and informative description of the 1952 meeting of the International Astronomical Union in Rome, and wound up his talk by showing slides of some of the European Observatories, including the new observatory at Herstmonceaux Castle and the Observatory of the University of St. Andrews. Mr. Gordon Shaw expressed the hearty thanks of the meeting to the speaker for his most interesting talk.

E. R. GIBSON, *Recorder*

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